Navy Dental takes a bite out of MERCURY

Navy Is International Leader in Managing Dental Mercury

Though the dentist's drill will continue to be a source of dread for many, the Navy has developed techniques for making dental offices easier on the environment.

For over 100 years, the wastewater originating in dentist offices has contained traces of mercury, which is a naturally occurring element that can also be found in air, water and soil. Overexposure to mercury in humans can lead to tremor, fatigue and anger, all the way up to severe disorders of the central nervous system and even death. Developing fetuses and young children are particularly susceptible to health hazards from mercury. While the vast majority (87 percent) of anthropogenic, or manmade, mercury emissions come from the burning of fossil fuel for the generation of electricity or the incineration of waste in municipal waste combustors and medical waste incinerators, the United States Environmental Protection Agency (EPA) is interested in limiting the release of all anthropogenic sources of mercury, including wastewater.

Dental amalgam—or the metal in "fillings," as most people know it—is an alloy composed of mercury, copper, tin and silver, and has been in use for over 150 years. During the placement and removal of fillings, a small portion of the mercury seeps into the wastewater. Wastewater treatment facilities are not designed to remove

Dental Officer Lt. Joseph Wigfield completes a routine filling. The Naval Institute for Dental and Biomedical Research found mercury present in dental wastewater and so installed filters at Navy clinics.

U.S. Navy photo by Photographer's Mate Airman Lindsay Switzer

While researching the presence of mercury in dental wastewater, the Naval Institute for Dental and Biomedical Research (NIDBR) discovered that a certain amount of dental amalgam is retained in the wastewater lines. However, NIDBR has identified several enzyme-based products that clean the suction lines while releasing very little mercury from the trapped amalgam.

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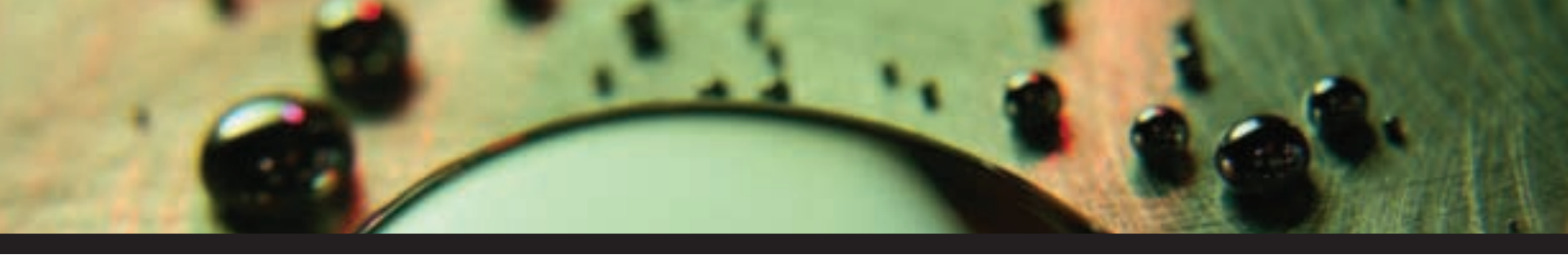
toxic chemicals and metals, so trace amounts of mercury can eventually migrate into receiving bodies of water. A typical American dentist will use an average of .9 to 1.4 kilograms, or between 1.98 and 3.09 pounds, of dental amalgam each year.

In spite of the presence of mercury, dental amalgam is considered to be a safe and effective dental material for restoring decayed teeth. In 1997, the Federation Dentaire Internationale (FDI) World Dental Federation and the World Health Organization issued a consensus statement on dental amalgam stating, "No controlled studies have been published demonstrating systemic adverse affects from amalgam restorations" and that "the small amount of mercury released from amalgam restorations, especially during placement and removal, has not been shown to cause any adverse health effects."

The Navy began studying dental mercury 10 years ago after the Hampton Roads Sanitary District in Norfolk, VA, required another



large clinic nearby to disconnect its dental wastewater stream from sanitary lines due to mercury spikes in the wastewater. Shortly thereafter, then-Chief of the Dental Corps, RADM R.P. Morse, tasked the Naval Institute for Dental and Biomedical Research (NIDBR) with helping the Dental Center in Norfolk to mitigate mercury release. At that time, samples taken from air-water separating tanks fed by some dental facilities showed mercury levels of between 20 and 10,000 milligrams (mg) per liter. Many publicly owned treatment works (POTW) have mandated discharge limits of .05 mg per liter. Before the Navy's research, dental mercury was thought to be inert and not absorbed by biological organisms.

In 1994, the NIDBR, formerly the Naval Dental Research Institute, in Great Lakes, IL, designed and implemented a system that combined sedimentation, filtration and ion exchange technologies. The new system proved to reduce mercury levels to those allowable

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The Navy installed the Hg-20 filtration system in its larger dental clinics after the Naval Institute for Dental and Biomedical Research discovered mercury, which originated in dental amalgam, was present in dental wastewater. The MRU 400 filtration system has been installed in the Navy's smaller clinics.

U.S. Navy Dentist Capt. John Labanc extracts a wisdom tooth from a patient.

U.S. Navy photo by Photographer's Mate 3rd Class Elizabeth Thompson

under POTW limits by first removing the particulate by settling or filtration; and then oxidizing the remaining "dissolved" mercury to its ionic form (Hg+2) and trapping it by affinity resins or ion exchange columns that remove ionic mercury.

Another important discovery made by the Navy during dental mercury research is the fact that a large amount of the mercury is retained in the wastewater lines themselves, never leaving the building. Oxidizing line cleaners such as household bleach can liberate this mercury, releasing it back into the wastewater stream. However, NIDBR has identified several enzyme-based products that clean the suction lines while releasing very little mercury from the trapped amalgam.

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The Navy's mercury management system "removes a major source of contamination to the environment, assures compliance with regulatory agencies and puts the Navy in the forefront of the effort to minimize the environmental impact of the practice of dentistry," said Dr. Mark Stone, research dentist and Navy dental mercury program project manager. "The U.S. Navy is now a recognized international leader in the management of dental mercury."

Other materials designed to remove mercury are being tested by the NIDBR, including sulfur-containing resins and also a novel microbial biosorbent derived from genetically engineered bacteria. Developed at the Naval Research Laboratory in Washington, DC, the biosorbent is capable at removing 94 percent of mercury from dental wastewater.

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